work for students of bio- and organic chemistry interested in porphyrins, heme, and chlorophyll. In addition, because of the recently defined relations between the heme protein cytochrome P-450, microsomal oxygenase reactions, the induction of drug-metabolizing enzymes, and the control of heme formation via the induction of δ-aminolevulinate synthetase, the book will be of great interest to pharmacologists and clinicians as well.

In the first chapter, the reader is introduced to the nomenclature of the porphyrins and their metal complexes, the properties of various cytochromes, other heme proteins, and the various chlorophylls and vitamin B_{12}. The next two chapters summarize the organic chemistry of the pyrroles and pyrrolic pigments, describing the newer methods of synthesis and degradation of these compounds which have become available since the publication of the volumes by Fischer and Orth in the late 1930's. Included is a summary of the ingenious synthesis of chlorophyll devised by Woodward and his co-workers. These chapters are written with particular clarity and succinctness; they will be especially valuable to the biochemist since biochemical reviews on the porphyrins have generally not adequately covered the organic chemical aspects of these compounds. The physical-chemical properties of the porphyrins are covered in another chapter, which also includes the absorption-spectral characteristics of the tetrapyrroles in the visible, ultraviolet, and infrared regions and the newer proton magnetic resonance and mass spectral data relating to these substances. Another chapter describes the various analytical methods that have been applied to complex mixtures of porphyrins from biological and synthetic sources. These include countercurrent distribution, chromatography, and electrophoresis. It was highly satisfying for me—recalling the struggles of years past—to note how these various physical and physicochemical methods now make possible the routine analysis of trace amounts of these materials for structural, quantitative, and other determinations. The last two chapters review the various steps in heme and chlorophyll biosynthesis, the disorders of porphyrin metabolism associated with certain genetic defects in man, and the experimental porphyrias elicited by various drugs, chemicals, and natural steroids. These latter subjects are being quite actively investigated at present, so that reviews of them rapidly become dated. However, these last chapters should prove most useful as an introduction to the biochemistry and pharmacology of the porphyrias.

The book is, in brief, a much-needed and elegantly written text. Workers in this field—which has so many biologic and medical ramifications—will be grateful to Marks for this lucid compilation of information.

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A Question about Periodicity

The Biological Clock. Two Views. FRANK A. BROWN, JR., J. WOODLAND HASTINGS, and JOHN D. PALMER. Academic Press, New York, 1970. viii, 94 pp., illus. Paper, $1.95.

In the preface of this brief volume the authors express the hope that it "will serve as an introduction to those uninitiated in the field. . . ." That the book fails to achieve this goal is due more to its overall organization than to the specific material it contains. It is focused exclusively on the question of whether biological clocks are driven by unknown exogenous periodic variables or derive their periodicity from endogenous biochemical oscillations. The uninitiated reader will certainly come away with the impression that this is the central question in the study of biological clocks. Nothing could be further from the truth. By any standard the field is a very broad one which has raised and continues to raise more exciting and more approachable questions. In fact, at the moment I do not know of a single laboratory in which the exogenous-endogenous question is being directly approached experimentally, for the very good reason that a definitive test must involve experiments mounted on a satellite in solar orbit to exclude all possible influences of the earth's rotation.

The book does provide a reasonably good introduction to the exogenous-endogenous controversy, an understanding of which is important to a full appreciation of the broader subject. It is, however, only an introduction and will not enable the reader to make an intelligent judgment without a good deal of further reading and study. This is not the fault of the authors but a result of the book's format. In such a brief, nontechnical treatment it is of course impossible to go into much detail in support of one's position. Unfortunately, in this particular controversy the side one is led to take depends precisely on a careful evaluation of such details—specifically, on one's judgments concerning statistical manipulation of data from particular experiments and the relative reliability of experiments that have yielded conflicting results. As an example, Brown describes at length conclusions based on studies of the oxygen consumption rhythms of the developing chick but does not discuss very careful studies by Heusner which led him to the conclusion that oxygen consumption in developing chicks is completely arhythmic.

The controversy described has had considerable impact on the development of the study of biological clocks and may yet reappear in modified form as an issue of central importance (although probably not until a great many more questions are answered). At the moment continued flogging of the exogenous-endogenous horse is not likely to yield even a muffled heuristic whinny. After all, the two sides agree that there must be a great deal of interesting biological machinery involved, the analysis of which is surely our major task.

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Macromolecules

Progress in Molecular and Subcellular Biology. Vol. 1. B. W. AGRANOFF, J. DAVIES, F. E. HAHN, H. G. MANDEL, N. S. SCOTT, R. M. SMILLIE, and C. R. WOESE. Springer-Verlag, New York, 1969. viii, 238 pp., illus. $14.

Here we have the beginning of still another series, "Progress in. . . ." What is the area to be covered in this series and how well does the first volume fulfill its intended function? The title is not informative, since molecular and even subcellular biology can mean all things to all men. The lead article by Fred Hahn, "On molecular biology," does not answer the question but rather addresses itself to Stent's gloomy prognostication that all the molecular biology that will be, has been. This reviewer agrees with Hahn that this attitude is hardly a universal one. Hahn cites areas where our ignorance is overwhelming and where answers probably will not constitute a "simple extrapolation of the basic dogma."

The articles indicate that macromolecular metabolism, function, and organization constitute a major focus of the series. "Organelle biosynthesis: chloroplasts" is an example of perhaps the best of this genre of survey article. The subject is of considerable interest and probably unfamiliar to many workers in "molecular biology" inasmuch as plants have not yet become highly fashionable. This fascinating organelle provides an excellent example of semiautonomous genetic information used to form and maintain a highly differentiated structure within the cell cytoplasm. Its formation can be conveniently triggered, and specific inhibitors of many of its macromolecular synthetic processes are known. The subject is reviewed clearly and competently.

The article by Mandel on the incorporation of 5-fluorouracil into RNA and its molecular consequences is an extensive review of a large and disparate literature which would constitute practically mandatory reading for anyone considering the use of this or other analogs that are incorporated into RNA.

"Errors in translation" summarizes what is known about the fidelity of amino acid incorporation and especially the drug-induced ambiguities.

"The biological significance of the genetic code" by Woese contains a concise account of the history of the breaking of the code. The "biological significance" actually means the author's speculations about the evolution of the protein synthesis apparatus. This reviewer's personal prejudice has never permitted enthusiasm for this type of reasoning, and I am skeptical of the idea that RNA-DNA hybridization data really indicate much about a primitive ribosome; others may find such speculation more to their taste.

Finally, a brief article by Agranoff on "Macromolecules and brain function" states clearly that this is a field of inquiry that is in, to say the least, a primitive state. A number of interesting and mystifying phenomena are described, as well as the author's own studies on the effect of metabolic inhibitors on memory, from which very modest conclusions are drawn. The article serves a useful function in indicating the complexities and difficulties awaiting those who, perhaps with youthful exuberance, might decide to launch into the problem of "brain function."

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New Findings from Antarctica

Antarctic Ecology. Based on a symposium, Cambridge, England, 1968. M. W. HOLDGATE, Ed. Published for the Scientific Committee on Antarctic Research by Academic Press, New York, 1970. 2 vols. Vol. 1, xx, 604 pp., illus., $18.50; vol. 2, xx, 394 pp., illus., $14.

This is the report of the second symposium on antarctic biology, held at the Scott Polar Research Institute at Cambridge, England, in 1968. Both that symposium and the first one, held in Paris in 1962, were arranged by the Scientific Committee on Antarctic Research (SCAR) of the International Council of Scientific Unions. The results of the first symposium were published under the title *Biologie Antarctique* by Hermann & Cie. in 1964. That volume consisted of largely preliminary outlines of knowledge of systematics and ecology of antarctic biota, partly based on short periods of study. The new two-volume work is another landmark, representing a great advance over the former.

The large number of contributions to this remarkable collection is such that merely to list authors and titles would occupy most of the space allotted for this review. A total of 101 authors and co-authors appear; there are 81 articles, arranged in 14 sections each of which includes an editor's introduction and a discussion. The subjects of the sections are: vol. 1—Past Environments, Marine Ecosystems, Plankton and Its Pelagic Consumers, The Pelagic Resources of the Southern Ocean, Marine Benthos, Fishes, The Biology of Seals, Adaptation in Seals, Ecology of Antarctic Birds; vol. 2—Freshwater Ecosystems, Soils, Vegetation, Terrestrial Fauna, Conservation.

This collection presents a remarkable assemblage of information on antarctic ecology and its ramifications, including the more pertinent aspects of the nature and history of the physical environment. Much of the information is new. There is great emphasis on the marine environment, productivity, and potentials of utilization in a context of wise conservation.

Adie indicates that the eastern, Gondwana, portion of the continent is Paleozoic and the western, Andean, portion much younger—Mesozoic and Tertiary—and that many fundamental factors, such as multiple glaciation, sea-level fluctuation, paleomagnetism, climatic variation, and paleogeography, are significant in affecting the present occurrence of life on the continent. In the Pleistocene the ice sheet was larger than at present (Hollin). Sea-bottom deposits present much history of ice erosion and also show two periods of rapid cooling, 2.5 million and 0.7 million years ago, respectively (Hays).

The dry valleys near McMurdo Sound constitute unique environments. They partly form one of the driest spots known on earth, but also contain some lakes over 60,000 years old, with frozen upper layers, warm bottom layers with great concentrations of various salts, and no circulation (Wilson).

The climate warmed 10,000 years ago, but the Antarctic Convergence (where cold antarctic waters sink beneath the temperate waters) may have been 5 degrees farther north at antarctic glacial maximum, when land biota would have been lost or restricted (van Zinderen Bakker).

Much attention is devoted to the marine environment in all aspects. The potential importance of krill as a world food is stressed. Knox shows that the marine environment varies only between +3° and −2°C, that productivity is surprising, that there are more species at greater depths, that many are very large, that sessile species are dominant, and that the standing crop is much richer than that of the Arctic. Hedgpeth reports that bipolar species are very few, that biomass may be 5 to 10 times that of the Arctic, that group compositions differ, and that the Arctic Sea may have been a frozen lake when the seas were colder. Dunbar shows that animals can adapt to low temperatures, that growth rates may be slow but there is compensation in large body size and extensive egg production. El Sayed indicates that the Pacific is poorer than the Atlantic in phytoplankton, and that the antarctic coastal waters, 70° to 75°S, are the most productive. Zermova shows that most phytoplankton are diatoms and there is a bloom between January and April. Balech indicates that dinoflagellates and tintinnids are highly endemic and radiolarians are more abundant than in other seas. Kozlova shows that diatoms decrease from surface downwards. Belyaeva states that Foraminifera are denser near the continent and especially south of New Zealand. Voronina stresses seasonal cycles and shows that copepods make up 73 percent of biomass of mesoplankton. Makarov *et al.* show that krill feed upon phytoplankton. Several authors discuss krill predation by fish, whales, and others and discuss possibilities of whale